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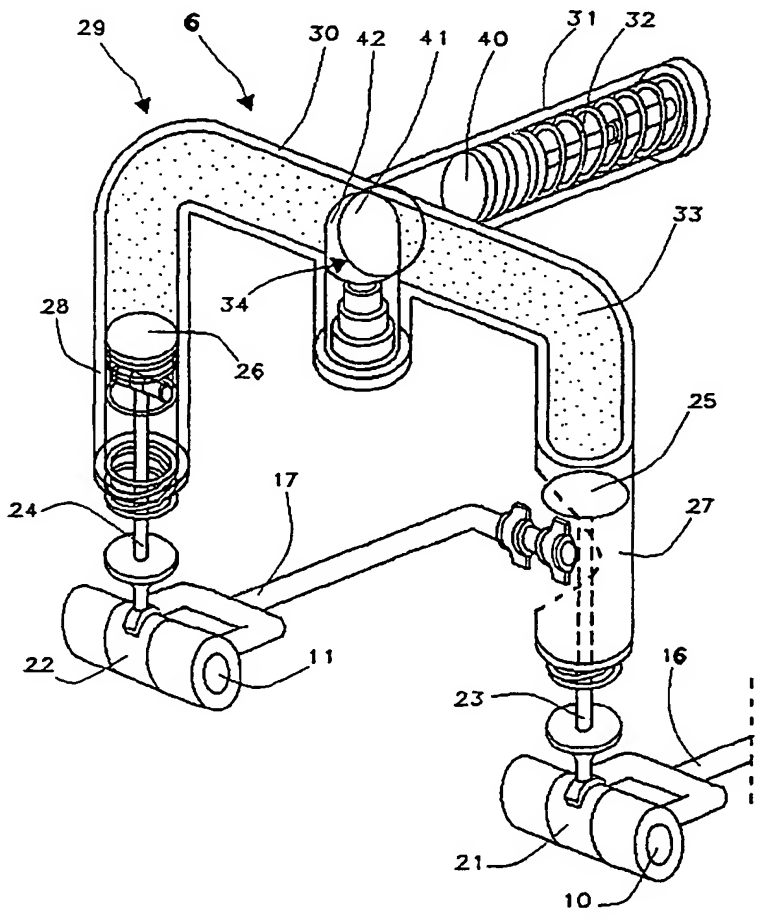
(54) Title: THREE-WHEEL VEHICLE WITH POSITION STABILIZER



(57) Abstract: Three-wheel vehicle comprising a front steering wheel (2) and a pair of rear driving wheels (3, 4), supported at the ends of two respective oscillating arms (16, 17), the other ends of which are hinged onto the vehicle frame (6) about a horizontal axis, said arms being reciprocally connected through balancing means apt to transmit to one of the arms an oscillation in a direction and to an extent opposite to those of the other arm. Said balancing means comprise two pairs of hydraulic cylinder-piston units (27-25 and 28-26), one for each oscillating arm (16, 17), the chambers of the two cylinders (27, 28) being reciprocally connected through a duct (29) of hydraulic fluid (33) under pressure. Said balancing means comprise means to stop the oscillation of said arms (16, 17), consisting of a control valve (34) interposed along said duct (29) and apt to be automatically actuated on stopping of the vehicle and/or when driving below a predetermined critical speed, so as to stop the flow of fluid.

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"THREE-WHEEL VEHICLE WITH POSITION STABILIZER"

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The present invention concerns a vehicle, particularly a three-wheel motorvehicle equipped with a position stabilizer.

As known, three-wheel vehicles of this type generally comprise a stiff rear axle, housing support means for a pair of rear side-by-side driving wheels, and a front steering wheel.

Consequently, the known three-wheel vehicles bear onto the ground in a relatively stiff manner in correspondence of three points.

Such three-wheel vehicles do not allow to incline the vehicle while taking a curve, whereby it is not possible to follow a curve with utmost safety and at a certain speed.

A further drawback of such known three-wheel vehicles lies in the fact that, when wishing to park the vehicle across the edge of a sidewalk or onto a stretch of ground sloping crosswise, the vehicle forcedly takes up an inclined position in respect of the vertical axis; this could determine a rather unsteady condition for the three-wheel vehicle. Furthermore, when the vehicle is parked in a slightly inclined position, even if steady, it becomes difficult to either get into or get out of the vehicle.

Some of these drawbacks have actually already been solved in the vehicles described in EP-B1-0.606.191, EP-B1-0.626.307, FR-A1-2.616.405 and WO.98/43872. These prior art documents propose three-wheel motorvehicles wherein the axle for the pair of rear driving wheels is divided in two half-axles, carried at the ends of two respective oscillating arms, balancing means being moreover provided to control the compensated oscillation of said arms in a manner such that, to the movement of an arm in one direction there may correspond an equal movement of the other arm in the opposite direction.

Nevertheless, in the vehicles described in the aforecited documents, the balancing of the oscillations of the two rear wheels is obtained through means whose efficiency is not always satisfactory. The main drawback of such known vehicles lies in the fact that, the more they allow a sufficient freedom of oscillation of the two wheels in opposite directions - said freedom being a fundamental condition for a correct driving of

the vehicle, particularly along bends, when the driver needs to incline the vehicle in order to oppose the action of the centrifugal force - the less they allow to keep the balance in parking conditions of the vehicle.

The object of the present invention is to thus overcome the drawbacks of known technique by proposing a three-wheel vehicle which is not only apt to tilt when taking a curve, or to remain in a perfectly vertical position along a rectilinear path also on a stretch of ground sloping in a transversal sense, but which allows above all to control at any moment the vertical positioning of the vehicle, even in parked conditions.

According to the present invention, these objects are reached with a three-wheel vehicle having the characteristics described in Claim 1.

The three-wheel vehicle according to the present invention will now be described in further detail, with reference to the embodiment illustrated by way of example on the accompanying drawings, in which:

Fig. 1 is a side view of a three-wheel vehicle;

Fig. 2 is a back view of the same vehicle;

Fig. 3 is a front view of the same vehicle;

Fig. 4 diagrammatically illustrates the rear axle of the vehicle positioned on a horizontal plane;

Fig. 5 is a view similar to that of fig. 4, but with the vehicle following a bend;

Figs. 6 and 7 are views similar to that of fig. 4, but with the vehicle positioned on an inclined plane sloping rightwards and, respectively, leftwards;

Fig. 8 is a diagrammatic perspective view of the rear structure of the vehicle, with the two wheels and the respective suspension and driving means;

Figs. 9 and 10 are, respectively, a diagrammatic plan view and a front elevation of the same driving unit shown in fig. 8; and

Figs. 11 and 12 show, respectively, the hydraulic circuit of the stabilizing unit and a diagram of how said unit operates, according to the present invention.

As shown in fig. 1, the vehicle 1 has a front wheel 2 and two rear wheels 3, 4.

The three-wheel vehicle 1 has a body 5 which, in the embodiment illustrated, comprises only the driver's seat, but which could comprise two tandem seats as normally provided on motorcycles.

Fig. 2 is a back view of the vehicle 1, placing in evidence the shape of the body 5, the rear wheels 3, 4, and the front wheel 2.

Also fig. 3, which is a front view of the vehicle 1, places in evidence the shape of the body 5, supported by the wheels 2, 3, 4.

Figs. 4 to 7 illustrate the driving conditions of the frame 6 including the rear wheels 3, 4, with the vehicle in running conditions, taking into account the vehicle structure described hereinafter.

As diagrammatically illustrated in figs. 8, 9 and 10, the half-axles 10, 11, of the pair of rear wheels 3, 4, are mounted on bearings fixed at the ends of the oscillating support arms 16 and 17 respectively, each arm being hinged at the other end onto pivoting pins 18, 20, fixed to the body 5 of the vehicle 1.

From figs. 8, 9 and 10 it can be seen that the wheels 3, 4, are supported at the outer ends of the half-axles 10, 11. Onto the inner ends of said half-axles 10, 11, there are keyed gearwheels 12, 13, each gearwheel being driven by a chain 14, 15, or by similar means. The chains 14, 15, are driven by the engine (not shown) of the vehicle, in known manner, by way of two pinions 12a, 13a, keyed on two half-shafts 12b, 13b, connected to a differential unit D. It is important to note that the axis of the half-shafts 12b, 13b, coincides with the axis of the pivoting pins 18, 20, of the oscillating arms 16, 17, so as to allow a correct motion transmission independently from the momentary position of the oscillating arms 16, 17.

Rods 23, 24, are moreover mounted on said half-axles 10, 11, by way of further bearings 21 and 22 respectively. Each rod 23, 24, is connected to a respective piston 25, 26, slidably housed into a cylinder 27 and 28 respectively. These cylinders are connected to the body 5 of the vehicle 1 by way of means, known per se, which allow a limited freedom of movement, as illustrated for example in fig. 8 or in fig. 10.

As shown in figs. 11 and 12, the chambers of the cylinders 27, 28, are connected together by way of a tubular duct 29. Generally, the duct 29 can be formed by sections of a flexible pipe, of the type used - in known manner - for example in the hydraulic braking circuits. The inner chamber of the cylinders 27, 28, as well as the inner part of the duct 9 are filled with a hydraulic fluid, for instance oil, indicated by reference 33.

In the scheme reported in fig. 11, the cylinders 27, 28, are illustrated as the end portion of a tubular body having an essentially overturned U-shape, of which the cylinders 27, 28, form the two vertical branches, while the transversal branch consists of a section of horizontal connection pipe 30; this scheme is simply meant to indicate that the hydraulic fluid 33 contained in the chambers of the cylinders 27, 28, and in the tubular duct 29, must flow from one chamber to the other without meeting any obstacles - except for the element mentioned hereunder - as if the cylinders 27, 28, and the duct 29, were to actually form a single chamber.

In a substantially central position of the duct 29 there is arranged a valve 34, which allows to control the flow of the hydraulic fluid 33 moving from the cylinder 28 towards the cylinder 27, or respectively from the cylinder 27 towards the cylinder 28, according to two valve positions: fully open, or fully closed. In the fully closed position - diagrammatically illustrated in fig. 12 - there is no possibility to move the fluid 33 from one cylinder to the other; in the fully open position, as said, the fluid 33 is apt to freely flow from one cylinder to the other, and also towards a shock absorbing system as described hereunder.

In fact, a shock absorbing system is connected to the centre of the duct 29, said system being diagrammatically illustrated in fig. 12 as a simple sealed chamber 40.

In the scheme reported in fig. 11, the shock absorbing system is instead represented by a pipe section 31, closed at one end, while its other open end 41 communicates with the central portion of the horizontal pipe 30, said pipe section 31 housing a piston 40 acting against the action of a respective spring 32. The pipe 31 is in turn filled with the same hydraulic fluid 33 which fills the horizontal pipe 30. The control valve

34 is represented in fig. 11 as a piston 42 acting against the action of respective spring means.

The control valve 34 is preferably conceived as a solenoid valve, apt to receive the controls for the open and, respectively, closed positions from an automatic control system (for instance of the electronic type), illustrated only diagrammatically in fig. 12. Said system uses signals essentially issued by a sensor of momentary speed of the vehicle 1, so as to control the closing of the valve 34 when the vehicle speed drops below a critical level, of reference, which corresponds to the minimum speed of equilibrium of the vehicle itself. This allows to obtain the following driving positions of the vehicle:

a) In normal running conditions, along a flat rectilinear path - as illustrated in fig. 4 - the valve 34 is open. The fluid 33 is equally distributed in the two branches of the duct 29, and the two pistons 25, 26, are positioned at the same level. The communication with the chamber of the pipe 31 is open and, thanks to the fluid 33, the shock absorbing system (40) is apt to perform its function.

b) In normal running conditions, along a flat curved path - as illustrated in fig. 5 - the valve 34 is still open. The increased weight on the rear inner wheel 3 pushes upward the rod 23 and the respective piston 25; at the same time, the rear outer wheel 4, deprived of its load, drops downward drawing along the rod 24 and the respective piston 26. This opposed symmetrical movement is allowed thanks to the fact that the fluid 33 freely flows into the duct 29, moving from the chamber of the cylinder 27 to the chamber of the cylinder 28. Also in these conditions, the shock absorbing system (40) performs its function.

c) In normal running conditions, along a rectilinear path which is not flat but sloping either rightwards or leftwards - as illustrated in figs. 6 and 7 respectively - the valve 34 is still open. As can be seen, the wheels are positioned on different horizontal levels. Consequently, in the case of fig. 6, the rear wheel 4 moves along a higher path, while the rear wheel 3 moves along a lower path; nevertheless the axis X of the frame 6, and thus of the vehicle 1, keeps in a vertical

position. In the case of fig. 7, the rear wheel 3 is in a lifted position in respect of the path followed by the rear wheel 4, but also in this case the axis X of the frame 6 keeps in a vertical position. As in the previous case, this positioning is allowed thanks to the fact that the fluid 33 freely flows into the duct 29, moving from one chamber to the other of the cylinders 27 and 28. Also in these conditions, the shock absorbing system (40) is apt to perform its function.

Thus, as one may gather from the previous points a), b), c) of the description, in any of the normal running conditions of the vehicle the driver is able to perfectly control the same in its vertical or inclined position, exactly as if it were a vehicle - as a motorcycle - with a single rear wheel: in fact, in all the conditions illustrated in figs. 4 to 7, the displacement of the wheels between a higher and a lower position is always allowed by the free flowing of the fluid 33 towards the chamber of one cylinder or of the other, or towards the shock absorbing system, through the duct 29 and thanks to the open valve 34.

d) Whereas, in running conditions of the vehicle below a certain critical speed - namely, the minimum speed of equilibrium at which a common two-wheel motorcycle would no longer be able to keep in a vertical position - and in stopping conditions, the speed sensor issues a signal which operates the automatic control system in order to control the closing of the valve 34. In this way, whatever the position of the wheels with the vehicle in a vertical standing - kept up to a few seconds before according to the conditions of the road surface - the suspension system of the vehicle wheels is blocked, so as to make sure that the vehicle keeps in said vertical standing.

The driver will thus not be forced to promptly set his feet on the ground when reaching the minimum speed of equilibrium, in order to keep the vertical position of the vehicle, nor does he need to fear the oscillation and upsetting of the vehicle when stopping and abandoning the same, as it happens with the conventional two-wheel motorcycles or even with the more recent three-wheel motorcycles, when they get to stop on a ground surface which is even slightly inclined or anyhow not perfectly horizontal.

It is of course appropriate to provide also a manual control system for the valve 34, for instance by means of a push-button placed under the control of the driver. Such an arrangement is actually required when the driver intends, for example, to face a change in the road surface running at very low speed: at this speed, the valve 34 is already closed by the automatic control system and, if the inclination of the road surface should vary, the vehicle could easily upset. Consequently, if the driver foresees such a situation, he can manually control the opening of the valve so as to allow the vehicle to keep in a vertical position while its suspensions adjust themselves to the new road surface.

The fundamental characteristic of the present invention - that is, keeping the vertical standing of the vehicle associated to the freedom of oscillation of the suspensions up to the critical speed, and then blocking the vehicle in said position below said speed - is of fundamental importance when wishing to produce a three-wheel vehicle having a closed body with a door on each side, or at least a door on one side, which cannot be found at present on the market. In fact, with such a closed-body arrangement, the driver has no possibility to set his feet on the ground, when slowing down, in order to keep the position of equilibrium: it hence becomes indispensable to automatically block the vehicle in a vertical standing.

It is anyhow understood that the invention is not limited to the particular embodiment described heretofore, which merely forms a non-limiting example thereof, but that different variants can be introduced, all within reach of a person skilled in the art, without thereby departing from the protection scope of the invention itself, as defined in the following claims.

CLAIMS

1) Vehicle, particularly three-wheel vehicle of the type comprising a front steering wheel (2) and a pair of rear shortly spaced side-by-side driving wheels (3, 4), which are supported at the ends of two respective oscillating arms (16, 17), the other ends of which are hinged onto the vehicle frame (6) about a horizontal axis, said arms being moreover reciprocally connected through balancing means apt to transmit to one of the arms an oscillation in a direction and to an extent opposite to those of the other arm, characterized in that, to said balancing means there are associated means to stop the oscillation of said arms (16, 17), and in that said means to stop the oscillation are actuated on stopping of the vehicle and/or when driving below a predetermined critical speed.

2) Vehicle as in claim 1), characterized in that,

- said balancing means comprise two pairs of hydraulic cylinder-piston units (27-25 and 28-26), one for each oscillating arm (16, 17), interposed between this latter and the vehicle frame (6), the chambers of the two cylinders (27, 28) being reciprocally connected through a duct (29) of hydraulic fluid (33) under pressure, and

- said means to stop the oscillation of said arms (16, 17) consist of a control valve (34), interposed along said duct (29) of fluid (33) under pressure and apt to stop, under control, the flow of said hydraulic fluid (33).

3) Vehicle as in claim 2), wherein said control valve (34) is actuated by an automatic control system, positioned on the vehicle.

4) Vehicle as in claim 3), wherein said automatic control system comprises sensors of momentary speed of the vehicle, and is apt to control the closing of said valve (34) when the sensor detects a vehicle speed which is below said predetermined critical speed.

5) Vehicle as in claim 1) or 3), wherein said predetermined critical speed is the minimum speed of equilibrium of the vehicle.

6) Vehicle as in claim 3), wherein said valve (34) is placed under the control of manual actuating means.

7) Vehicle as in any one of the previous claims, wherein each of the vehicle rear wheels (3, 4) is mounted on its own half-axle (10, 11), supported at the free end by the respective oscillating arm (16, 17).

8) Vehicle as in claim 7), wherein said half-axles (10, 11) are motor-driven, each through a respective driving unit carried by the respective oscillating arm (16, 17), the two driving units being operated by a common motor unit.

9) Vehicle as in claim 8), wherein said common motor unit comprises a differential unit (D).

10) Vehicle as in claim 9), wherein the outlet of said differential unit (D) is connected to pinions (12a, 13a) meshing with said driving unit, the axis of said pinions coinciding with the rotation axis of the respective oscillating arms (16, 17).

11) Vehicle as in claim 7) or 8), wherein each half-axle (10, 11) carries at its outer end the respective driving wheel (3, 4), while onto its inner end there is keyed a respective gearwheel (12, 13) meshing with a respective chain (14, 15) forming said driving unit.

12) Vehicle as in any one of claims 2) to 11), wherein the piston (25, 26) of each cylinder-piston unit is pivotally connected to a respective half-axle (10, 11) by way of its own rod (23, 24), and is slidably housed into its cylinder (27, 28) which is freely connected to the vehicle frame (6).

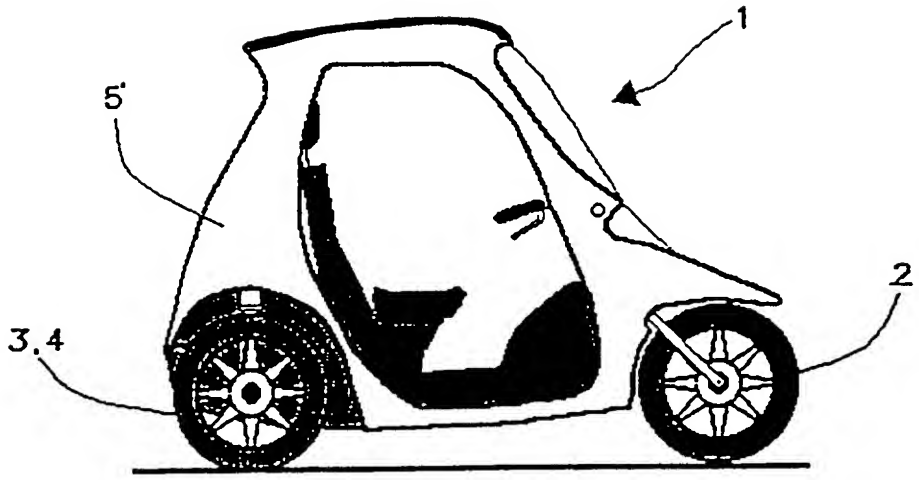


Fig. 1

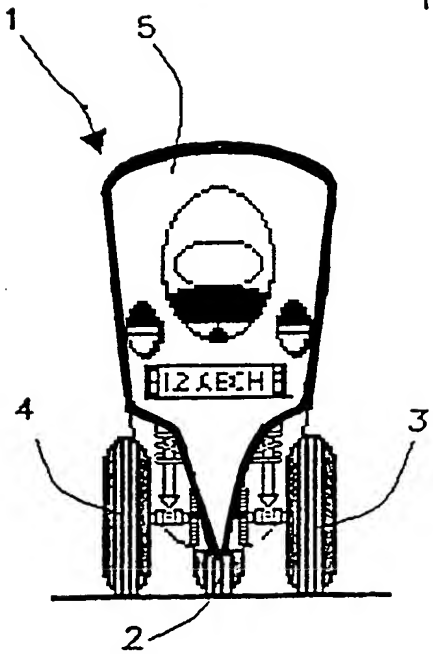


Fig.2

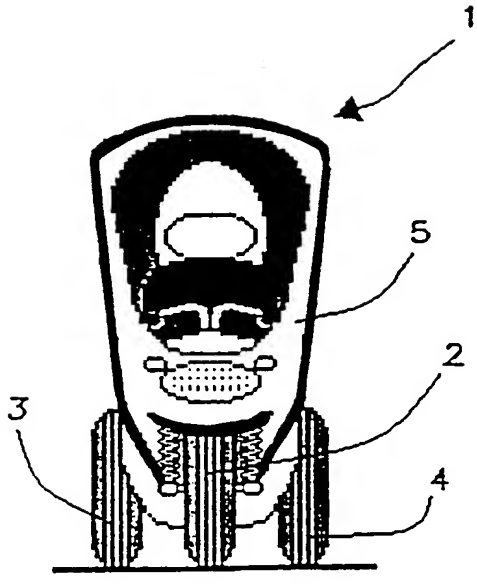


Fig.3

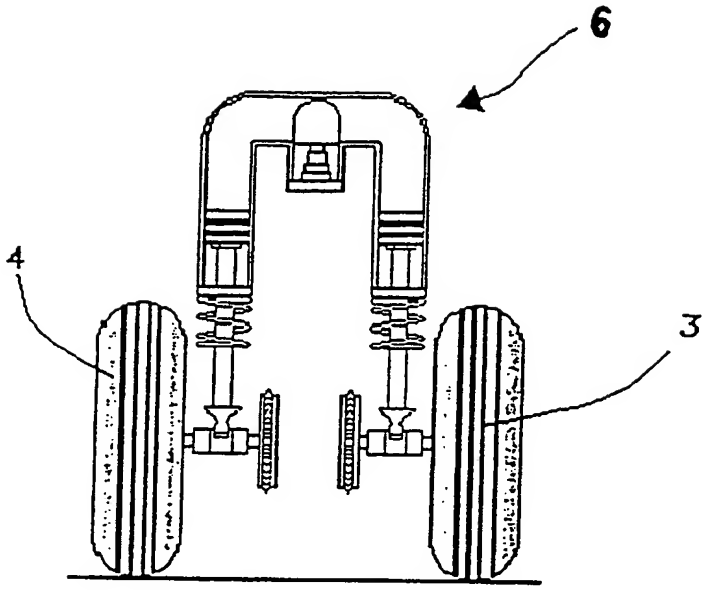


Fig.4

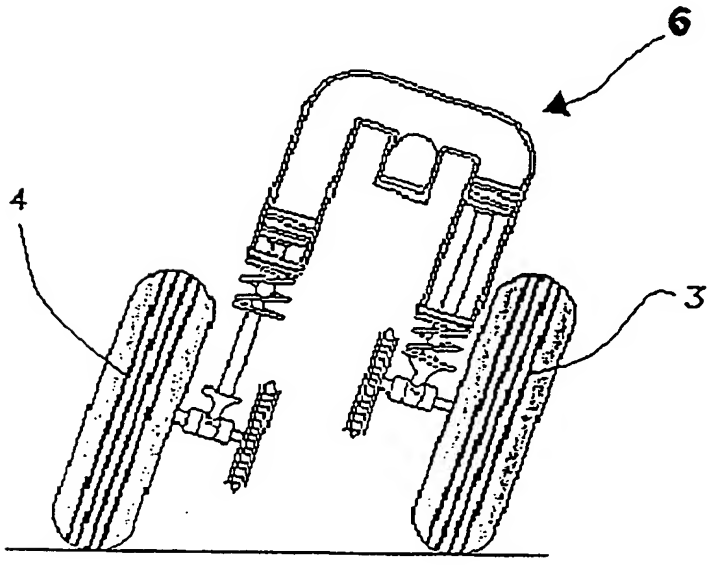


Fig.5

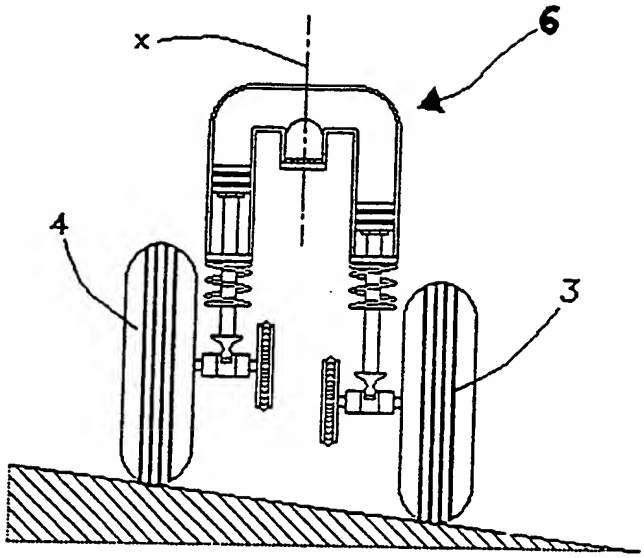


Fig.6

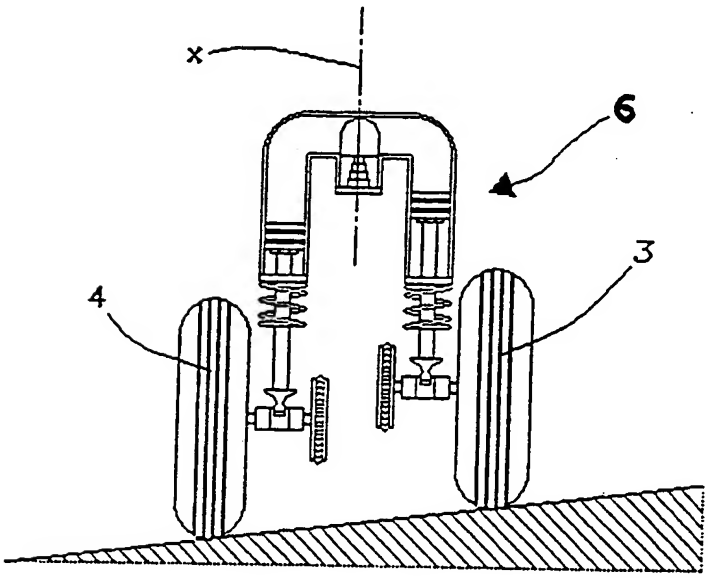


Fig.7

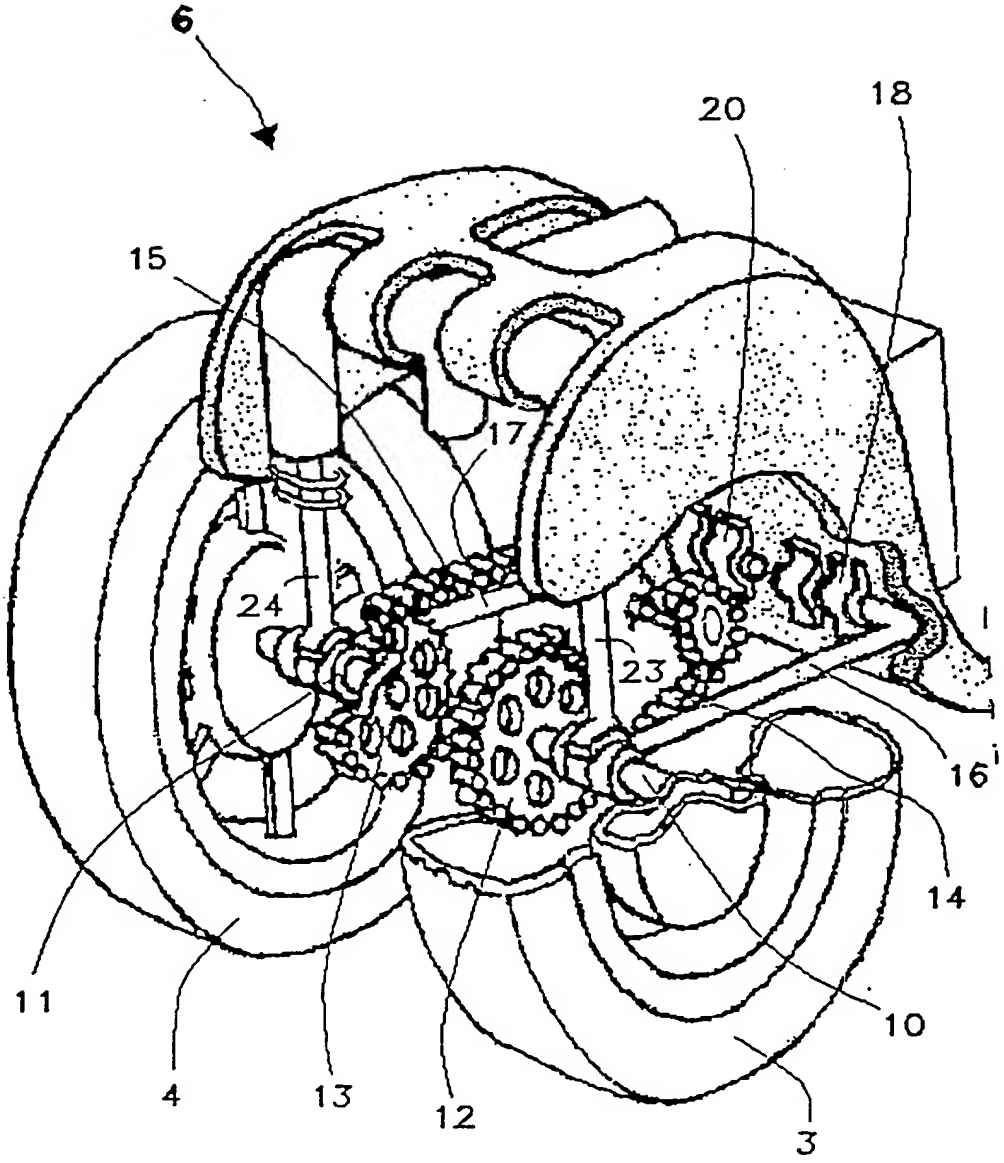


Fig.8

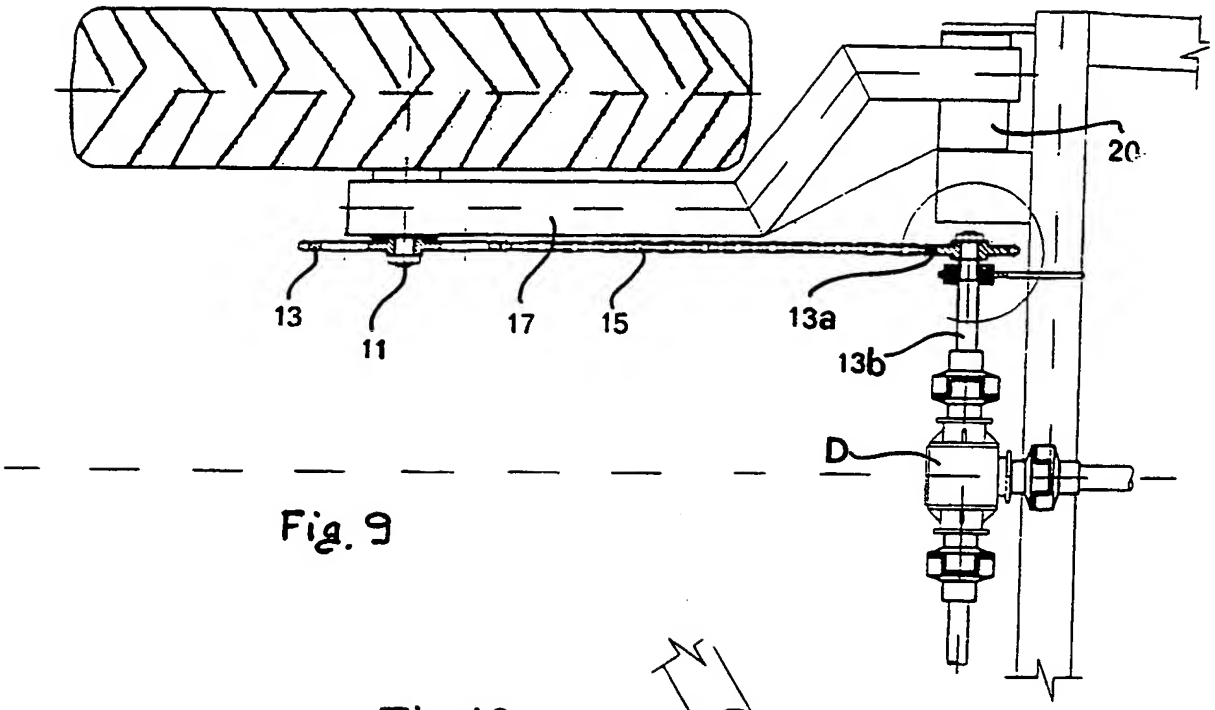
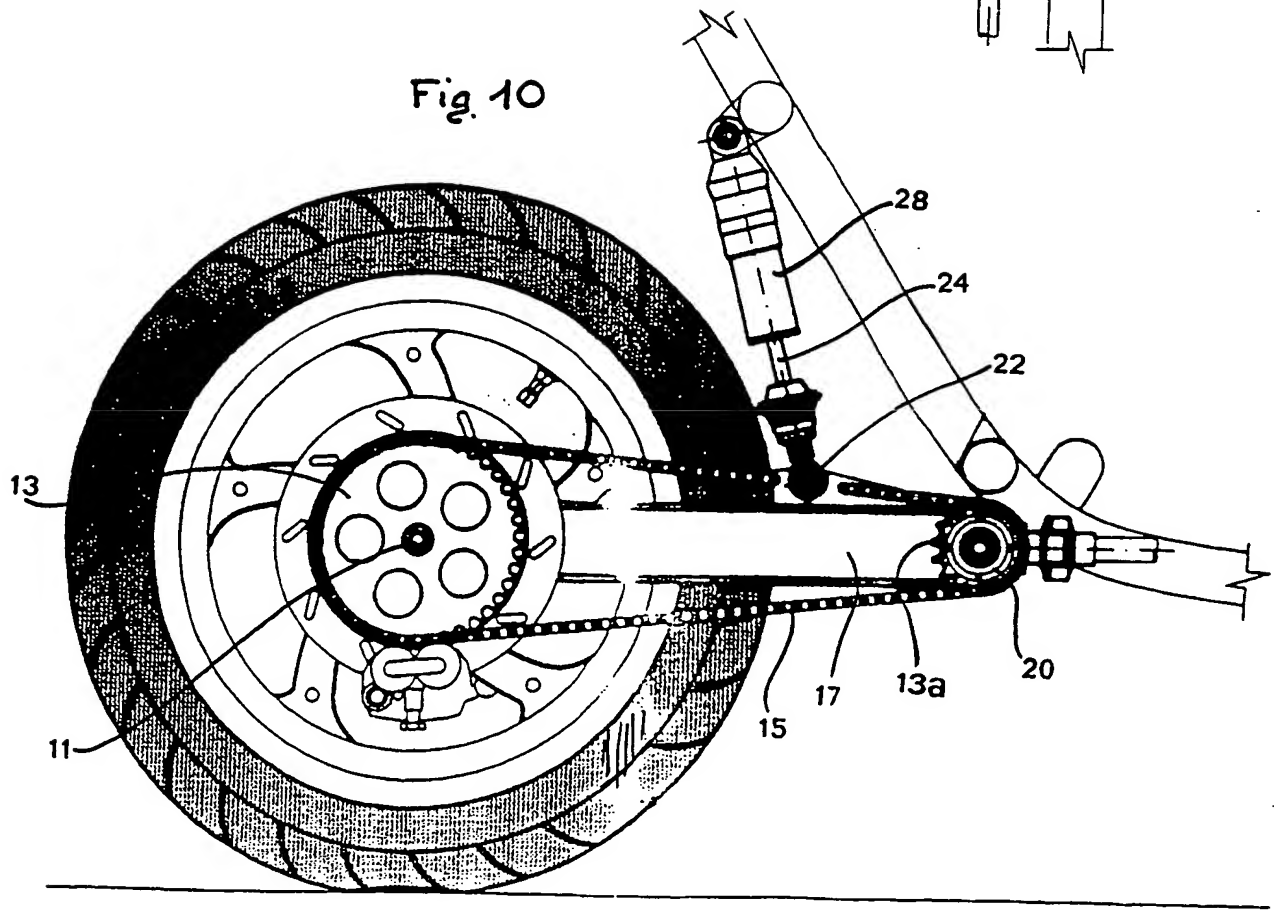


Fig. 9

Fig. 10



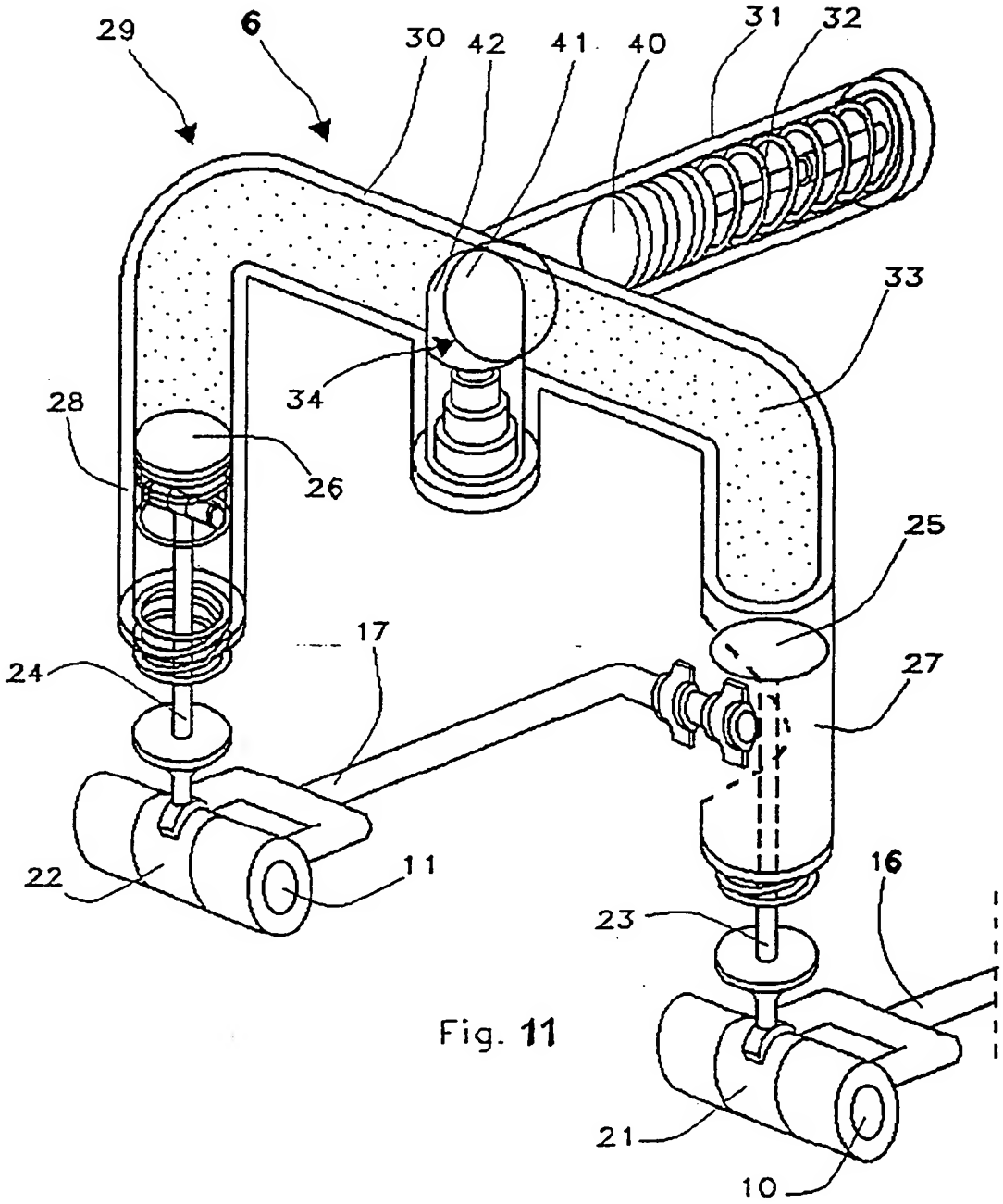


Fig. 11

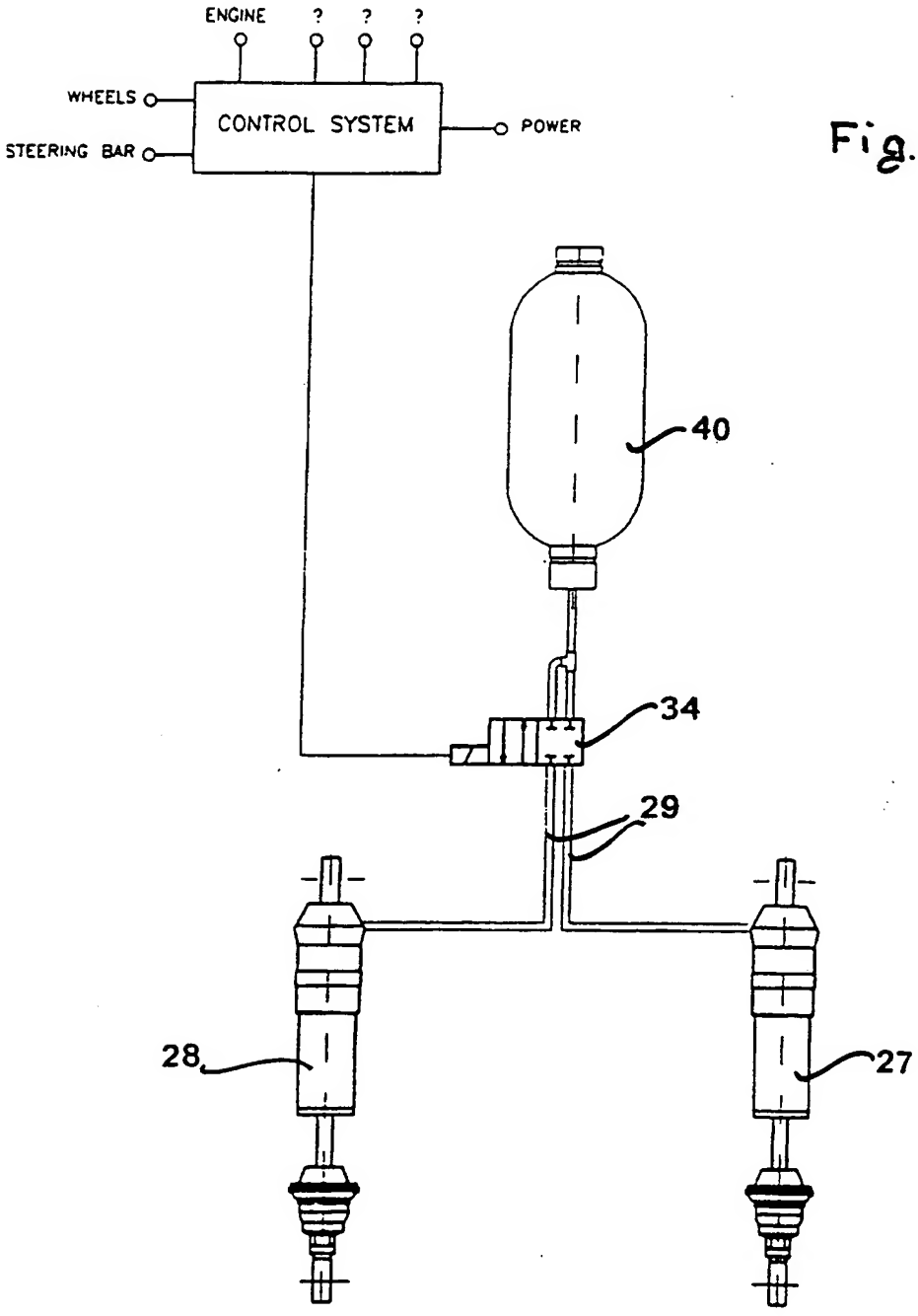

ENGINE
?
?
?
WHEELS
STEERING BAR
CONTROL SYSTEM
POWER
40
34
29
28
27

Fig. 12

INTERNATIONAL SEARCH REPORT

Int. tional Application No
PCT/EP 00/11403

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B62D9/02 B62D61/08 B60G21/10 B62K5/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B62D B60G B62K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 27071 A (GEISER FRIEDRICH) 31 July 1997 (1997-07-31) page 3, line 34 -page 5, line 24 page 13, line 25 -page 14, line 13 page 16, line 34 -page 17, line 1 figures 11,12	1-6
Y	---	7-12
Y	DE 197 08 633 A (JELKE RICHARD) 10 September 1998 (1998-09-10) column 1, line 68 -column 2, line 15; figure 1	7-12

X	DE 94 14 724 U (HUBER ERNST) 24 November 1994 (1994-11-24) page 4, last paragraph -page 5, paragraph 2; figure 1	1-3,6

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
15 March 2001	26/03/2001

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/EP 00/11403

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	DE 40 35 128 A (HOERMANN ERNST DIPL ING) 17 June 1992 (1992-06-17) column 14, line 52 -column 15, line 31; figures 7,8 ---	1,2
X	US 4 047 732 A (WILLIAMS JERRY K ET AL) 13 September 1977 (1977-09-13) column 3, line 45 -column 4, line 4; figures 1-3 -----	1,2,6

INTERNATIONAL SEARCH REPORT

Information on patent family members

In ational Application No
PCT/EP 00/11403

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9727071 A	31-07-1997	AT 403566 B	25-03-1998
		AT 13896 A	15-08-1997
		AT 188172 T	15-01-2000
		DE 59700927 D	03-02-2000
		EP 0876263 A	11-11-1998
DE 19708633 A	10-09-1998	NONE	
DE 9414724 U	24-11-1994	DE 4423859 A	10-08-1995
DE 4035128 A	17-06-1992	NONE	
US 4047732 A	13-09-1977	NONE	